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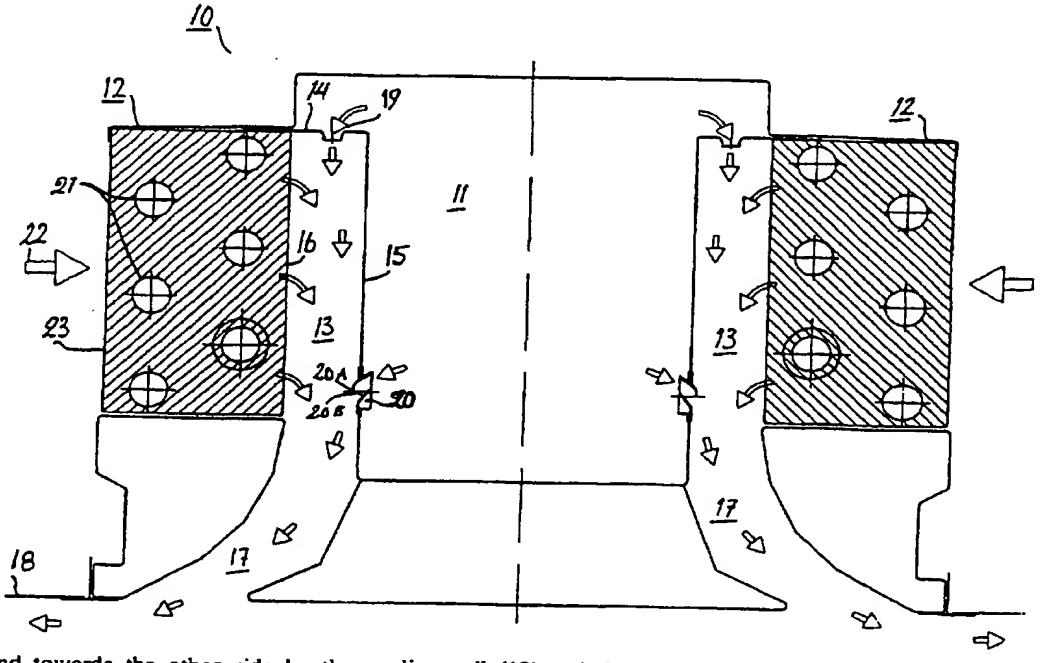
(54) Title: AN APPARATUS FOR COOLING INDOOR AIR

(57) Abstract

An apparatus for cooling indoor air which comprises a horizontally extending primary air duct (11) having essentially vertical long side walls (15), at least one cooling coil (12) for room air and a mixing chamber (13) for primary and room air and openings (17, 23) for the flowing of circulation air into and from the room. The apparatus is characterized in that cooling coils (12) are provided with space outside and along one or both of the vertical long side walls (15) of the primary air duct (11), thus forming a long narrow room (13) constituting said mixing chamber which is defined upwards by an upper partition wall (14) over a projecting part of the primary air duct (11), towards the one side by the vertical long side wall (15) of the primary air duct (11) and towards the other side by the cooling coil (12) and downwards has a direct connection to respective openings (17, 23), which in turn has connection with the room. Each cooling coil (12) has openings (22, 16) provided for an essentially horizontal input air flow from the room and an output flow to the mixing chamber (13) of air cooled in the cooling coil (12), respectively. Openings (19) for primary air are provided in the upper partition wall (14) between the part of the primary air duct (11) projecting over the mixting chamber (13) and corresponding mixing chamber (13) so as to provide an input primary air flow to the mixing chamber (13) being parallel with the side of the mixing chamber (13) facing to the cooling coil (12) and thus also essentially perpendicular to the chilled room air flow streaming out from the cooling coil (12) and into the mixing chamber (13).



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AN APPARATUS FOR COOLING INDOOR AIR

The invention relates to an apparatus for cooling indoor air which comprises a horizontally extending primary air duct having essentially vertical long side walls, at least one cooling coil for room air and a mixing chamber for primary and room air and openings for the flowing of circulation air into and from the room.

The use of false ceiling panels or profiles provided with cold water chilled elements, which apparatuses also are called cooling baffles, for the treatment of room air is well known. These cooling baffles are advantageuos in comparison with ventilation and air conditioning systems, since they are power saving and do not generate noise nor draught. The baffles can also be combined with air ducts for supply of non-preconditioned primary air.

Cooling baffles usually consist of a frame of metal profiles. These are constructed and attached to a ceiling in such a way that warm room air is admitted to flow vertically in an upwards direction between the panels of the baffle, whereafter this warm air is chilled by cooling elements in the baffle to sink downwards in the baffle as a result of its increased density. Thus, the baffles provide a self-circulation of the air and a regulation of its temperature inside a room. As examples of such an apparatus can be mentioned GB-B-1011742, wherein primary air is supplied perpendicular to the plane of the ceiling, and WO 94/24491 (Farex AB), wherein primary air is admitted to be supplied obliquely against the air flow in the lower part of the mixing chamber. Such baffles primarily use the so called chimney effect by causing warm air to flow upwards and also in those cases when primary air is supplied it is nevertheless the chimney effect which shall be the dominating factor, since primary air only is supplied in order to regulate the flow of air streaming into the room. As a consequence there is needed a certain minimum height of the apparatus in order to effectively make such a chimney effect possible. It is also known to design such baffles in a way to permit the room air to be sucked up into the apparatus from above by means of a dominating induction effect from supplied primary air. Such a baffle must however be mounted at a distance from the ceiling

being large enough to make possible the sucking up of the air from above into the apparatus, such as described in GB-A-2271175.

All prior art cooling baffles, false ceiling panels or the like consequently demands a relatively large height space when being ceiling mounted, either in order to provide an effective chimney effect or to permit an input flow from above. The latter is in turn necessary for permitting an output flow of the air into the room which is at least essentially horizontal.

The purpose of the present invention is to provide an apparatus for the cooling of room air which demands a smaller height space for the mounting if compared with prior art apparatuses having a horizontal air output flow, but which provides the same advantages seen from the flow technical point of view. Thus it is of a very essential especial importance in modern buildings, which often have a restricted floor to ceiling height, to be able to offer such an apparus having a lower mounting height but without waiving the flowing path pattern. For this purpose the invention is characterized by the features which are set forth in the patent claims.

The apparatus according to the invention has cooling coils provided with space outside and along one or both of the vertical long side walls of the primary air ducts. A long narrow room is thus formed constituting the mixing chamber for primary air and room air (chilled) between each cooling coil and vertical long side wall of the primary air duct. The mixing chamber is upwards defined by an upper partition wall over a projecting part of the primary air duct, towards the one side by a side partition wall in the form of the vertical long side wall of the primary air duct and towards the other side by the cooling coils. Downwards each mixing chamber has a direct connection to respective opening which in turn has connection to the the room. Each cooling coil has openings provided for an essentially horizontal input air flow from the room and an output flow to the mixing chamber of air cooled in the cooling coil, respectively. Openings for primary air are provided in the upper partition wall between the projecting part of the mixing chamber and corresponding mixing chamber so as to provide an input

primary air flow to the mixing chamber being parallel with the side of the mixing chamber facing to the cooling coil and thus also essentially perpendicular to the chilled room air flowing out from the cooling coil and into the mixing chamber.

In a preferred embodiment further primary air openings are provided in the vertical partition wall between the primary air duct and the mixing chamber in question. Said further primary air openings are preferably provided obliquely downwards at a height being on the level of the lower part of the duct. The openings in the vertical partition wall consist preferably of spray nozzles being adjustable to give a variable amount and/or direction of the primary air. The primary air openings provided in the upper partition wall preferably are spray nozzles located with a space of 12-50 mm along the entire length of the cooling apparatus.

The cooling apparatus according to the invention has the cooling coils located vertically with the circulation air openings provided on their sides as opposed to the conventionally location at the top of the coils. As already is indicated in the above cooling apparatuses of the actual art normally are designed to provide a chimney effect cooperating and coacting with the induction effect caused by the primary air supply. By giving priority to the induction, i.e. the ejector effect which may be caused by means of the supplied primary air flow, and also the air distribution paths through the apparatus by providing a minimized circulation air duct, i.e.the mixing chamber, an optimal air flow without any swirls and with the lowest pressure drop being possissible in practice is obtained. Complementary to what can be called the "primary" primary air flow, which means the flow into the circulation air duct from above, i.e. the mixing chamber room, as described in the above adjustable spraying nozzles may be provided further down in the vertical partition wall of the circulation air duct and more close to the lower part of the primary air duct. These spray nozzles are primarily used for such regulation of the air which give an essentially horizontal output air flow along the ceiling of the room, but these nozzles may also be utilized for supplying additional primary air if a large primary air flow is requested.

The invention will now be further decribed with reference to accompanying drawing, in which Figure 1 is a sketch showing the principle of the apparatus seen from a side section in a longitudianal direction, and Figure 2 is a sketch illustrating the principle function of an adjustable spray nozzle provided in the apparatus according to a preferred embodiment.

In Figure 1 there is shown a cooling apparatus or baffle, here designated 10, according to the invention. The cooling baffle 10 cosists of a primary air duct 11 and on each side thereof are provided cooling coils 12. Due to local requests or demands the baffle 10 may in certain cases be designed with a cooling coil 12 only at one of the sides of the primary air duct 11. Between the primary air duct 11 and each cooling coil 12 there is a mixing chamber 13, also called circulation air duct, which is defined by an upper partition wall 14, here extending horizontally, a vertically extending partition wall 15 to the primary air duct and the vertical, inwardly directed output flow part 16 of the cooling coil 12. Downwardly, the circulation air duct end in an obliquely downwardly directed outflow air flow duct 17 along the ceiling 18 of the room below the baffle 10. There is a first set of downwardly directed primary air openings 19 provided in the upper partition wall 14 . These openings are in a preferred embodiment spraying nozzles mounted at a certain predetermined mutual distance. In the vertical partition wall 15 there is shown a second set of primary air openings 20, mounted in an obliquely downwardly direction, and being in the form of adjustable spraying nozzles having their upper and lower air flowing guiding profiles 20A and 20B, respectively. Each cooling coil 12 has a number of cooling pipes 21 for water, provided perpendicular to the through-flowing air 22 being supplied through input flow openings 23.

In operation the air is flowing from the primary air duct 11 down through the upper openings 19 of the cooling baffle 10 and thereby an under-pressure is created in front of the output flowing parts 16 of the cooling coils 12. The higher velocity of the air from the openings 19 the greater under-pressure will be established and thereby a greater air flow 22 will also be sucked in through the

coils 12. Primary air from the upper openings 19 and chilled room air flowing out from the out-flowing part 16 of the cooling coil 12 will meet in the circulation air duct (mixing chamber) 13. By means of the specific combination of constructional features, comprising the long narrow circulation air duct 13, being parallel to the supply flow of primary air, primary air and chilled room air will be mixed effectively essentially without the formation of any swirls and thereby also without a pressure drop of any greater magnitude, since the minimized long narrow space 13 supports a flowing close to and along the output flowing part 16 of the cooling coil 12. Since the mixed air flow is flowing out from the circulation air duct 13 in an essentially laminar state, i.e. without swirl formation of any dignity, the flow will follow the bending of the output flow duct 17 and thereafter flow out in a horizontally direction along the ceiling 18 of the room.

Figure 2 shows a spray nozzle 20 seen in a section parallel with the vertical partition wall 15. The figure shows the nozzle 20 in its neutral position 30 and in its end positions 31 and 32, respectively. In the neutral position 30 it is possible to turn the nozzle 20 towards both of the directions as indicated by a double arrow 33 and the air flows straight downwardly as indicated by an arrow 34. In its outmost positions 31 and 32, respectively, the primary air is by such turning directed to the left and right, respectively, as indicated by the arrows 35 and 36, respectively. In the sections of Figure 2 the one end of the upper flow guiding profile 20A is shown as a continuous line and the end of the lower profile 20B is shown as a broken line.

As a summary the following advantages of a cooling baffle apparatus according to the invention could be emphasized in comparison with prior art baffles of a similar art :

- A decreased necessary height space is demanded for the mounting, since no air gap width is necessary above the baffle, which consequently can be mounted direct against the ceiling.
- A decreased risk for dust pollution since no dust, which normally will cover any surfaces, will stay laying on the coils.
- An optimal induction function by the providing of a long primary air stream close to and along the vertical output flow part of the coils.
- A minimized circulation air duct (mixing chamber) because the primary air streams are allowed to follow a vertical surface (at the primary air duct side) and regulate all the through-flowing air without any unnecessary and unwanted swirl formation.
- Adjustable air spray nozzles (if any) inside the baffle for additional air flow and also for regulation of the air flow.

CLAIMS

1. An apparatus for cooling indoor air which comprises a horizontally extending primary air duct (11) having essentially vertical long side walls (15), at least one cooling coil (12) for room air and a mixing chamber (13) for primary and room air and openings (17,23) for the flowing of circulation air into and from the room, characterized in that cooling coils (12) are provided with space outside and along one or both of the vertical long side walls (15) of the primary air duct (11), thus forming a long narrow room (13) constituting said mixing chamber which is defined upwards by an upper partition wall (14) over a projecting part of the primary air duct (11), towards the one side by the vertical long side wall (15) of the primary air duct (11) and towards the other side by the cooling coil (12) and downwards has a direct connection to respective openings (17,23), which in turn has connection with the room, that each cooling coil (12) has openings (22,16) provided for an essentially horizontal input air flow from the room and an output flow to the mixing chamber (13) of air cooled in the cooling coil (12), respectively, that openings (19) for primary air are provided in the upper partition wall (14) between the part of the primary air duct (11) projecting over the mixing chamber (13) and corresponding mixing chamber (13) so as to provide an input primary air flow to the mixing chamber (13) being parallel with the side of the mixing chamber (13) facing to the cooling coil (12) and thus also essentially perpendicular to the chilled room air flow streaming out from the cooling coil (12)and into the mixing chamber (13).

2. An apparatus according to claim 1, characterized in further primary air openings (20) provided in the vertical side wall (15) between the primary air duct (11) and each mixing chamber (13).

3. An apparatus according to claim 2, characterized in that the further primary air openings (20) are provided obliquely downwardly close to the lower part of the duct (11).

4. An apparatus according to claims 2 and 3, characterized in that said openings (20) are spray nozzles being adjustable to provide a variable air amount per time unit and/or direction of the air.

5. An apparatus according to any of claims 1-4, characterized in that the primary air openings (19) in the upper partition wall (14) are spray nozzles placed at a mutual distance of 12-50 mm along the whole length of the cooling apparatus.

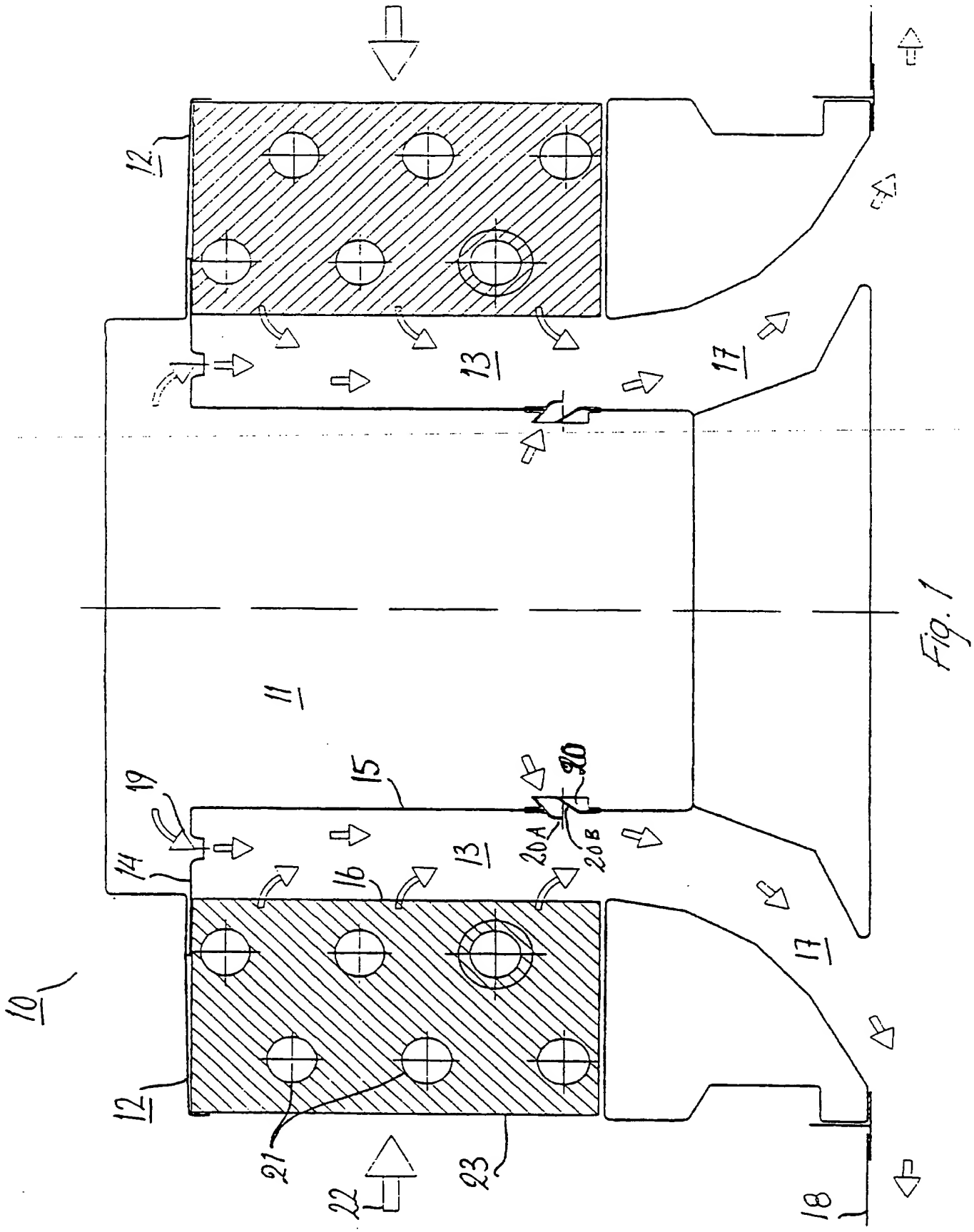

Fig. 1

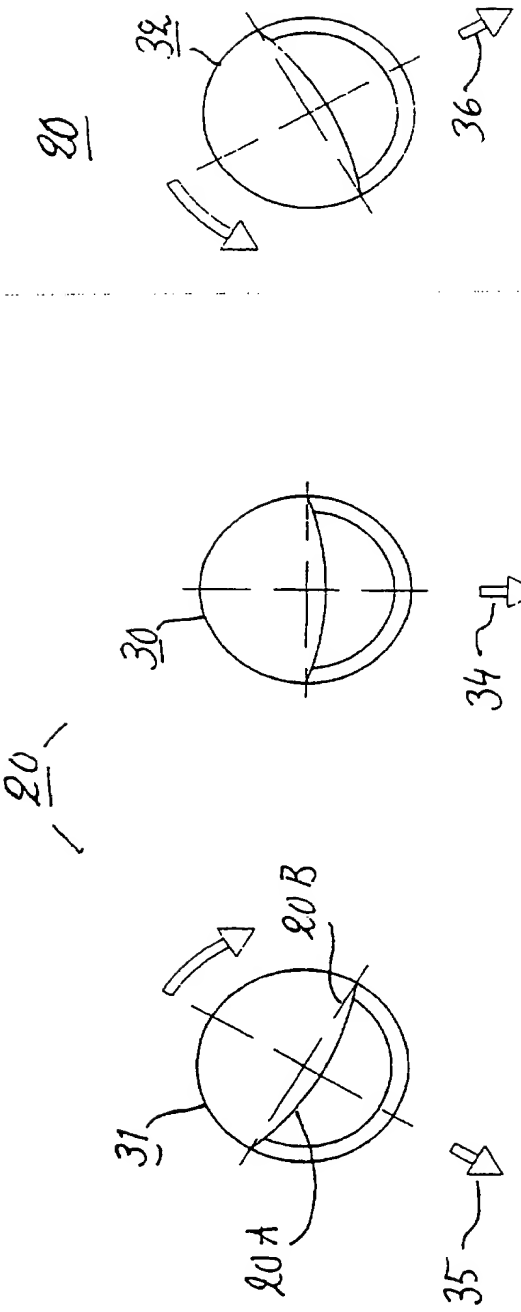

Fig. 2

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 97/01396

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: F24F 1/01, F24F 13/072
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: F24F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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Y	GB 2271175 A (HALTON OY), 6 April 1994 (06.04.94) --	1,5
Y	DE 3321612 A1 (HOWALDTSWERKE-DEUTSCHE WERFT AG), 20 December 1994 (20.12.94) --	1,5
Y	FR 1347152 A (ERCOLE MARELLI & S. S.P.A.), 18 November 1963 (18.11.63) --	1,5

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

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INTERNATIONAL SEARCH REPORT

Information on patent family members

01/10/97

International application No.
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INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 97/01396

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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